ELSEVIER

Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Clinical Microbiology and Infection 29 (2023) 414–416

Contents lists available at ScienceDirect

Clinical Microbiology and Infection

journal homepage: www.clinicalmicrobiologyandinfection.com

Commentary

Polio is back? The risk of poliomyelitis recurrence globally, and the legacy of the severe acute respiratory syndrome coronavirus 2 pandemic

Concetta Castilletti, Maria Rosaria Capobianchi*

Department of Infectious, Tropical Diseases and Microbiology, IRCCS Sacro Cuore Don Calabria Hospital, Negrar di Valpolicella, Verona, Italy

ARTICLE INFO

Article history:
Received 25 October 2022
Received in revised form
22 November 2022
Accepted 2 December 2022
Available online 8 December 2022

Handling Editor: S.J. Cutler

Keywords:
Death
Eradication
Permanent disability
Poliomyelitis
Sewage

After COVID-19 and monkeypox, here we are dealing with another scaring menace: polio. Many of us have certainly put the existence of poliomyelitis (polio for short) on the back burner; probably among the current doctors in service in western countries, there are very few who keep memories of this disease that plagued the years between the thirties and sixties. Years in which mothers lived in fear of their children being struck by an infection that was reputed to leave indelible and severe motor impairments, eventually leading to permanent iron lung imprisonment or even death.

The nightmare had been defeated, thanks to the discoveries of three scientists, Hilary Koprowski, Jonas Salk and Albert Sabin, who, with their studies at the turn of the 1950s and 1960s, made it possible to prepare the vaccine that defeated this monster [1]. Today's concerns arise from the recent, repeated reports of the presence of the virus in the sewage systems of places located in very distant points of the world, after years of relative silence. In March 2022, the virus popped up in Israel with human infections, most of which were asymptomatic [2]; since February in London, United Kingdom (UK) and since March in New York, United States (US), there have been repeated reports of the virus being found in the sewage system [2]. In the state of New York, in July, a human case of paralytic poliomyelitis occurred: it is the first time in almost 10 years that a case of polio has been registered in the US, after the last imported case, which occurred in 2013 [3].

Polio is a highly infectious viral disease that primarily affects children under the age of five, causing permanent paralysis (in about one out of 200 infections) or death (2%–10% of paralytic cases) [4]. However, there are cases of adults affected by this disease: a prominent example is the US President Franklin Delano Roosevelt, who suffered permanent polio disability after contracting polio in adulthood.

The virus is transmitted from person to person and spreads mainly by the faecal-oral route or, less frequently, by the consumption of contaminated water or food, and multiplies in the intestine, but can generate viremia, invade the nervous system and cause paralysis and death. Invasion of the nervous system with consequent disease and death occurs with a frequency of 10–100 times lower than infection. Initial symptoms of poliomyelitis include fever, fatigue, headache, vomiting, neck stiffness and pain in the limbs.

Of the three known strains of wild poliovirus (WPV1, 2 and 3), WPV2 and WPV3 have been declared globally eradicated, after a substantial number of years in which no cases have been reported worldwide [4]. To date, WPV1 is the only wild-type strain still circulating and is endemic in two countries: Pakistan and Afghanistan [4]. Occasional sporadic cases or small outbreaks in other countries are reported, testifying to the continuous risk of international spread even in polio-free countries, favoured by international travel and migratory flows. This is a very serious problem for our globalized world, and risk has further increased in the past 2 years owing to the decrease in immunization rate related to the COVID-19 pandemic.

As a matter of fact, risk of international spread of the poliovirus remains a public health emergency of international concern, according to the emergency committee convened under the International Health Regulations [5].

* Corresponding author. Maria Rosaria Capobianchi, Department of Infectious, Tropical Diseases and Microbiology, IRCCS Sacro Cuore Don Calabria Hospital, Via Don A. Sempreboni 5, 37024, Negrar di Valpolicella, Verona, Italy.
E-mail address: mrcapobianchi@gmail.com (M.R. Capobianchi).

https://doi.org/10.1016/j.cmi.2022.12.005
1198-743X/© 2022 European Society of Clinical Microbiology and Infectious Diseases. Published by Elsevier Ltd. All rights reserved.

There is no cure for polio, but the disease is preventable with a vaccine, which has been instrumental in marking the outstanding success achieved globally against this disease: cases have decreased from about 3 50 000 in 1988 to 175 in 2019 [4].

Today, two types of polio vaccine are used: inactivated polio vaccine developed by Salk and oral polio vaccine (OPV) developed by Sabin [6]. The first consists of inactivated poliovirus and establishes immunity in blood, preventing the virus from reaching the central nervous system from its primary infection site; it is not able to block infection in the digestive tract. The second, OPV, consists of attenuated live virus, is administered orally and establishes immunity at the mucosal level of the digestive tract, thus preventing natural infection from being established. As the virus contained in OPV replicates in vaccine recipients and is spread in the environment, it can infect and, therefore, immunize other individuals in the community as well [6]. This aspect certainly also represents the negative side of the coin; multiple cycles of infections and extensive circulation in the human population may lead the virus to accumulate mutations, a phenomenon common to all RNA viruses [7]. Some mutations can confer a pathogenic potential to the vaccine-derived virus, which may eventually cause clinical manifestations similar to those of the wild virus. To overcome these problems, a new version of OPV has been established, modified to lower the vaccine risk to a negligible level, at least for serotype 2. The WHO authorized the release of the novel OPV type 2 in November 2020, and 450 million doses have already been administered worldwide [8]. New generations of "live" poliovirus vaccines, targeting poliovirus serotypes 1 and 3, are in preclinical development, and the first clinical trials are expected to be completed in 2023 [9]. So, far, vaccine-derived poliovirus strains continue to circulate, and today, most cases of polio outside WPV1-endemic countries are due to circulating vaccine−derived poliovirus 2 (cVDPV2) strains [4]. As a matter of fact, cVDPV2 is the virus that has been isolated in the UK and the US [2]. Co-circulation of cVDPV2 and cVDPV3 has been reported in Israel [2].

As clinical manifestations are observed in a minimal part of infections, signals that we catch today from surveillance at the environmental level are indicating a transnational viral circulation, certainly larger than what can be appreciated through the raw data coming from the surveillance system itself.

With resolution WHA 41.28 of 13 May 1988, the WHO set the goal of eradicating the polio virus [10], launching the homonymous initiative "Global Polio Eradication Initiative" driven in conjunction with national governments, Rotary International, the US Centers for Disease Control and Prevention and United Nations Children's Fund and later joined by the Bill & Melinda Gates Foundation and the Vaccine Alliance Global Polio Eradication Initiative. Sadly, in 2020, the SARS-CoV-2 pandemic prompted a 4-month pause of the Global Polio Eradication Initiative's campaigns, disrupting disease surveillance and routine immunizations. More generally, in the past 2 years, global childhood vaccination rates against polio and other diseases like measles have declined drastically, largely due to the impact of the COVID-19 pandemic. Several recent reports confirm that the "new" outbreaks of measles and pertussis starting in unvaccinated individuals spread to children whose vaccination may have failed [11].

A surge of cases has been noticed in different parts of the world since 2020, with vaccine-derived poliovirus outbreaks having tripled from 2019 to 2020. The recent 2022 news is a strong reminder that the risk of polio resurgence is now present as never before, especially after the relaxation of preventive and control measures after almost 3 years of the COVID-19 pandemic. Thompson et al. [11], applying an established global model, clearly demonstrated as early as 2021 the difficulty of polio eradication unless aggressive efforts began soon after initial disease detection [12]. As they assumed, in the absence of aggressive measures, the virus would become globally endemic in 2−10 years, and cumulative paralytic cases would exceed 4−40 million.

At present, the healthcare setting is exhausted by the unequal struggle with the COVID-19 pandemic that is not yet over. Should we then lay down our weapons and retreat in the face of the new threats posed by the possibility of polio resurgence? Certainly not, and there is one thing that the COVID-19 pandemic has taught us: the importance of being prepared. It is, therefore, important to put in place all means to bring the circulation of the virus under control, keeping us on the path traced by the WHO for global eradication.

There are four pillars on which this trajectory is based:

1. The surveillance of Acute Flaccid Paralysis: all cases that occur in children/young people aged up to 15 years must be reported to the health surveillance system so that the aetiology of the individual cases can be determined, and any poliovirus and other infections can be promptly recognized [12].
2. Monitoring for the presence of poliovirus in the environment can be promptly recognized. As an example of environmental surveillance for poliovirus, the sewage systems of the main cities in western countries are regularly sampled to intercept the release of poliovirus in sewage waste by infected citizens; this system is very sensitive, as recent evidence from the US and UK has demonstrated and works with regard to asymptomatic infections, which represent the majority of the poliovirus infections [12]. Environmental surveillance (namely sewage analysis) can be extended to other emerging enteroviruses that can cause acute flaccid paralysis, like enterovirus D68, and possibly, to other environment-sable viruses. This strategy is presently applied in some countries, such as Italy [13].
3. Full implementation of vaccination policies, with the aim of keeping the national coverage thresholds for polio vaccination >95%, the threshold recommended by the WHO. In recent years, the increase in adverse movements to vaccination and the simultaneous decrease in the perception of the risk of infectious diseases have had a significant impact on vaccination coverage. It is essential to advocate to people about vaccine effectiveness, safety and relevance and to elaborate search strategies and how to flush out fake news. On the other hand, ongoing massive migration flows also deserve critical attention, because of the increased risk for the migrating populations to remain hidden from health surveillance systems, hence skipping the infectious disease prevention measures [14]. Therefore, identifying and proactively reaching population subgroups/areas with potential immunity gaps is a critical issue to be pursued.
4. Use of mathematical models to contribute to active surveillance programmes and preparedness can be very useful not only for polio eradication but, more generally, for infectious disease control. In fact, prospective modelling plays a critical role in analytic-deliberative processes by supporting the evaluation of strategies and decisions for managing risks in complex systems [11].

To conclude, one of the lessons that the SARS-CoV-2 pandemic has left us is that we do not know when to put an end to it, but in the meantime, we must stay vigilant and take advantage of all the available tools to prevent, intercept and fight infections that have the ability to spread, such as polio.

Author contributions

C.C. wrote the initial draft of the commentary. Both authors contributed to the final writing and editing of the commentary.

Transparency declaration

This work was supported by the Italian Ministry of Health “Fondi Ricerca Corrente” to IRCCS Sacro Cuore Don Calabria Hospital.

References

[1] Martini M, Orsini D. The fight against poliomyelitis through the history: past, present and hopes for the future. Albert Sabin’s missing Nobel and his “gift to all the world’s children”. Vaccine 2022;40:6802–5. https://doi.org/10.1016/j.vaccine.2022.09.088.
[2] European Centre for Disease Prevention and Control. Update on the polio situation in the EU/EEA and the world. https://www.ecdc.europa.eu/en/news-events/update-polio-situation-eueea-and-world. [Accessed 21 November 2022].
[3] Link-Gelles R, Lutterloh E, Ruppert PS, Backenson PB, St George K, Rosenberg ES, et al. Public health response to a case of paralytic poliomyelitis in an unvaccinated person and detection of poliovirus in wastewater—New York, June—August 2022. Am J Transplant 2022;22:2470–4. https://doi.org/10.1111/ajt.16677.
[4] WHO. Poliomyelitis. https://www.who.int/news-room/fact-sheets/detail/poliomyelitis. [Accessed 20 October 2022].
[5] Cochi SL, Hegg L, Kaur A, Pandak C, Jafari H. The global polio eradication initiative: progress, lessons learned, and polio legacy transition planning. Health Aff (Millwood) 2016;35:277–83. https://doi.org/10.1377/hlthaff.2015.1104.
[6] Modlin JF, Bandyopadhyay AS, Sutter R. Immunization against poliomyelitis and the challenges to worldwide poliomyelitis eradication. J Infect Dis 2021;224:S398–404. https://doi.org/10.1093/infdis/jiaa622.
[7] Savolainen-Kopra C, Blomqvist S. Mechanisms of genetic variation in polioviruses. Rev Med Virol 2010;20:358–71. https://doi.org/10.1002/rmv.663.
[8] Martin J, Burns CC, Jorba J, Shulman LM, Macadam A, Klapsa D, et al. Genetic characterization of novel oral polio vaccine type 2 viruses during initial use phase under emergency use listing—worldwide, March–October 2021. MMWR Morb Mortal Wkly Rep 2022;71:786–90. https://doi.org/10.15585/mmwr.mm7124a2.
[9] NIH. Study of novel types 1 and 3 oral poliomyelitis vaccines. ClinicalTrials.gov identifier: NCT04529538, https://clinicaltrials.gov/ct2/show/NCT04529538. [Accessed 22 October 2022].
[10] Rodrigues RN, Nascimento GLMD, Arroyo LH, Arcêncio RA, Oliveira VC, Guimarães EAA. The COVID-19 pandemic and vaccination abandonment in children: spatial heterogeneity maps. Rev Lat Am Enfermagem 2022;30: e3642. https://doi.org/10.1590/1518-8345.6132.3642.
[11] Thompson KM, Kalkowska DA, Badizadegan K. Hypothetical emergence of poliovirus in 2020: Part 1. Consequences of policy decisions to respond using nonpharmaceutical interventions. Expert Rev Vaccines 2021;20:465–81. https://doi.org/10.1080/14760584.2021.1891888.
[12] Global Polio Eradication Initiative World Health Organization. The four steps of acute flaccid paralysis (AFP) surveillance. https://polioeradication.org/who-we-are/strategic-plan-2013-2018/surveillance/. [Accessed 22 October 2022].
[13] Delogu R, Battistone A, Buttinelli G, Fiore S, Fontana S, Amato C, et al. Poliovirus and other enteroviruses from environmental surveillance in Italy, 2009–2015. Food Environ Virol 2018;10:333–42. https://doi.org/10.1007/s12560-018-9350-8.
[14] Tsagkaris C, Loudovikou A, Matiashova L, Papadakis M, Trompoukis C. Public health concerns over polio in war-torn Ukraine and nearby regions: four lessons and a warning from the history of epidemics. J Med Virol 2022;94: 2931–2. https://doi.org/10.1002/jmv.27723.